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C-O-N-T-E-N-T-S

The Relationship Between Date of Planting Green Mountain Potatoes and Yield of Tubers in Spraying Experiments on Long Island ..... H. C. Huckett

Certain Aspects of Potato Certification in Wyoming ..... J. S. Wiant

Acre Costs Versus Bushel Costs in Potato Production ..... C. M. McCrary

Potato Fertilizer ..... Albert E. Wilkinson

Knobby Seed May be Good Seed ..... C. L. Fitch

Crop and Market News.

Notes.

Reviews of Recent Literature.

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THE POTATO ASSOCIATION OF AMERICA

EAST LANSING, MICHIGAN

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The Relationship Between Date of Planting Green Mountain Potatoes and Yield of Tubers In Spraying Experiments On Long Island

H. C. HUCKETT, New York State Experiment Station, Riverhead, N. Y.

One of the most significant results in potato dusting and spraying experiments at the Long Island Vegetable Research Farm during the years 1926, 1927, 1928 and 1929 has been the high average yield of tubers obtained in plots receiving no treatment other than that for the control of the Colorado potato beetle. In comparison with the yield from plots sprayed from five to nine times with bordeaux mixture the yield of U. S. No. 1 grade tubers at no time was exceeded by more than seven bushels per acre.

It was evident by these results that the potato crop in certain sections of Long Island could to a large extent be "made" before the season arrived for the outbreak of more serious insect pests and diseases. In support of this assumption it has always been the policy in these experiments to plant the crop as early in the spring as possible. By this means the potato is in the soil well over three months before aphids and leafhoppers become injurious, a period which nearly represents the entire growth of the plant in more northerly regions.

With the object of ascertaining more definitely the role played by plant development in respect to insect and disease incidence during July and August, potato sets were planted during 1928 and 1929 on March 25, April 3, April 15, April 25, and May 5, a period which covered the planting season on Long Island.

The season of 1928 was very favorable for growth; insect pests were of minor importance; the most serious factor limiting production was an attack of late blight during July which caused the premature death of the foliage, especially amongst the older plants. Fortunately there was no tuber rot.

The season of 1929 was unfavorable for growth because of lack of rain during June and July; aphids and leafhoppers caused severe injury to the foliage during July.

During both seasons no serious attempt was made in these series of experiments to control insects or diseases other than the Colorado potato beetle.

During May and June frequent observations were made concerning the development and growth of the plants in the respective plots, all of which tended to support the assumption that the earlier the crop is planted the bigger the yield. By August 1 the vast majority of the plants had died down. Digging was delayed until September when the following yields were recorded.

TABLE 1. Yield of tubers in bushels per acre from plots planted at intervals during the spring.

Date Planted	1928 Total bu.	1928 U.S.No.1 bu.	1928 Odds*	1929 Total bu.	1929 U.S.No.1 bu.	1929 Odds*
March 25	361.9	330.0	16:1	166.5	131.3	1666:1
April 5	351.5	316.5	138:1	119.9	77.2	2499:1
April 15	325.8	293.0	587:1	83.1	44.8	66:1
April 25	287.5	250.0	10:1	69.5	32.7	2499:1
May 5	283.5	252.5		34.3	13.2	

The first thing that is plainly evident according to the above data is the striking effect of seasonal conditions on the general yield of the crop. In 1928 late blight was an important factor in killing the foliage prematurely, but under conditions that were particularly favorable for vegetable growth the yield cannot be said to have been seriously affected. In 1929 aphids and leafhoppers destroyed the foliage, and under conditions that were particularly unfavorable for growth the yield was a fraction of that in 1928. Since the amount of moisture was the most important difference influencing growth during 1928 and 1929 both directly and indirectly in so far as the factor of insect development was concerned, the results tended to emphasize the controlling influence that this requirement plays in the development of the potato crop on Long Island.

Further, it will be seen that the increase in yield of tubers during both seasons was invariably associated with the earliness

*Odds as to significance of results of earlier planting compared to that of the following.

at which the crop was planted. In the interpretation of such results it is thought that such differences provided further evidence as to the importance of moisture and indirectly soil temperature in influencing the development of the crop. To this effect the relatively early and prolonged cool spring season on Long Island is of peculiar importance to the potato farmer in more ways than one. This is significantly shown by the results obtained in 1929.

In pushing the argument to its logical conclusion one might hazard the statement that if such results were possible where no late spraying was done, how much greater the yield might have been if spraying had been continued. But such is not the case according to evidence obtained during 1929, at least in so far as such evidence might eliminate the factor of earliness in planting from further consideration. To obtain information on this point a duplicate series of experiments were planned and carried through during 1929 similar to those already described, with the exception that in addition to the four weekly spray applications prior to July 1st which were made in both series for the control of the Colorado potato beetle five more applications were made at weekly intervals after July 1st on the duplicate series only. These applications consisted of the standard arsenical-bordeaux mixture applied by means of a traction driven sprayer at the rate of 80-90 gallons per acre at 170-200 pounds pressure, such as is in use by many farmers on Long Island.

As the season progressed there was an appreciable difference in the condition of the foliage according to whether the plants had recently been sprayed or not. Aphid counts made in early July showed that the later planted potatoes which were coming into full bloom were more heavily infested than the earlier planted potatoes which had been in full bloom two weeks earlier. The yield of tubers from the various plots is given in the following table.

TABLE 2. Yield of tubers in bushels per acre from plots sprayed and not sprayed after July 1.

Date Planted	Plots Sprayed Late and Early		Plots Sprayed Early Only		Increase or Decr'se in Plots Sprayed Early and Late	
	Total bu.	No. 1 bu.	Total bu.	No. 1 bu.	Total bu.	No. 1 bu.
March 25	166.3	128.7	166.5	131.3	—.2	—2.6
April 5	136.8	96.1	119.9	77.2	16.9	18.9
April 15	96.3	59.8	83.1	44.8	13.2	15.0
April 25	95.7	61.8	69.5	32.7	26.2	29.1
May 5	70.6	46.1	34.3	13.2	36.3	32.9

According to the above data it will be seen that spraying continued during the later period of plant development did not overcome the necessity for early planting if maximum yields were to be obtained. Further, the benefit derived from later sprayings varied according to the age or development of the plant. Where potatoes were planted very early there was no evidence that later spraying increased the yield. Where potatoes were planted later there was evidence that the benefits derived from later spraying increased according to the lateness in planting. In two cases, namely the plantings of April 25 and May 5, the benefits derived from spraying were sufficient to exceed that obtained by the previous plantings on April 15 and April 25 respectively, which did not receive the later applications.

These results tend to confirm the assumption that early planting to a great extent helps the Long Island potato farmer to "make" a satisfactory crop, and enables him to cut losses that would otherwise occur due to the limitations of his spray practice.

Certain Aspects of Potato Certification in Wyoming

J. S. WIANT, University of Wyoming, Laramie.

The purpose of this paper is to briefly outline the growth of the certified potato industry in Wyoming, to call attention to the conditions under which the crop is produced, to discuss the potato disease situation in relation to seed production and to note the general features of the program for improving foundation stock.

Potato certification in this state was begun in 1920 as an extension service project of the state university. In 1927 the major part of the work was transferred to the Department of Agronomy with extension workers assisting in the outlying counties. The industry has grown from 100 acres in 1920 to nearly 6,000 in 1928. The decrease to 4,000 acres in 1929 was due to the market slump of the previous year. Although efforts are not being made to encourage the expansion of the seed industry it is believed that the acreage of the past several years are considerably lower than those which may be expected in the future. The bulk of the acreage (85%) is planted with the Bliss Triumph variety, the remainder being chiefly Cobblers with a few acres each of several other varieties. While many growers raise only 5 to 10 acres and several raise 100 to 200 acres the average is close to 20 acres per grower.

Irrigated fields are not eligible for certification. The entire crop is therefore produced on dry land farms, located for the

most part in the southeastern region of the state. Because of the high altitude (approximately 4,500 to 6,000 feet) the growing season is short. The average monthly precipitation for June, July, August and September is one and two-thirds inches. These two factors combined with the cultural practice of wide spacing between both hills and rows bring the average yield of marketable certified tubers close to 60 bushels per acre.

The low price of land ($8-$12 per acre) makes the growing of certified seed profitable with this yield. Most of the land under tillage has been broken within recent years. Thus during the past season 80% of the certified fields had never before been planted to potatoes. There are large acreages of unbroken range which are well adapted for growing certified seed in this region.

Before discussing the disease problems met with in the certification work, acknowledgement should be made for considerable personal assistance given to the members of our inspection staff during the past by investigators in neighboring states. It is further realized that in a paper of this kind some observations must be included which are applicable not only to Wyoming conditions but which confirm the published reports of various workers in other western states. Special emphasis is here given to the conditions which existed during the past two seasons.

Turning then to the topic of potato diseases, we find that Phytophthora blight rarely occurs in the dry farming region. Alternaria blight is not generally serious. None of the certified fields are sprayed or dusted. Losses from Rhizoctonia are chiefly those apparent in the bin. Scab and Fusarium wilt cause serious losses for a relatively small percentage of the growers. Blackleg was seriously present in certain seed-stocks during 1928. The virus diseases as a group constitute our most important problem especially when considered in their relation to the development and perpetuation of foundation stocks. Spindle tuber is without doubt one of the more serious of the virus diseases. Fortunately it is practically absent in one of our large seed-producing sections. The summer temperatures which prevail bring out the symptoms of this disease very clearly. Conditions in the dry land region are such however that the predominating type of mosiac (apparently mild mosaic) cannot be accurately recognized in the field.

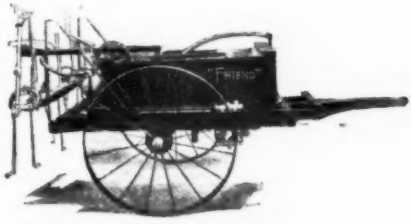
Our information on mosiac has been obtained from special tests made in the field at Laramie and from winter tests at the Weslaco substation in Texas. These indicate that mild mosaic is the most common type and that as in the case of spindle tuber the disease is of general occurrence in certain regions while of slight importance in other regions. Although special efforts have been made to detect leaf roll, in no case has this

disease been observed in fields entered for certification. Rugose mosaic and an undetermined disease (probably a combination of several virus diseases) are found occasionally. Undue emphasis has not been given to the results of the special tests since only 200 tubers were tested per grower. The close agreement between the results obtained at Laramie and those at Texas together with the consistency of the readings on different samples of the same seed stock do establish considerable confidence in the tests. These special tests have been supplemented by symptom-studies of potato virus diseases both at Laramie and at a state experiment farm in the dry land region. It should be stated that Laramie, with an elevation of 7,200 feet and a consequent lower mean summer temperature, affords an excellent location for a study of the the mosaic diseases. The disease situation may be summarized by the statement that approximately 8% of the acreage entered for certification is anunally rejected on field inspection.

The development and continued production of high grade foundation seed stock is the most important phase of our certification program. In order to familarize the growers with the present situation a detailed summary of the disease readings in all fields was sent to each. This included field readings as well as the results of the special tests. The report indicates that 30% of the acreage passing 1929 field inspection was practically free of disease. An additional 30% of the total acreage is represented by seed stock carrying less than 2% of the virus diseases. A large proportion of the better fields are located in one general region—referred to above as that section where spindle tuber is absent in most fields and where mosaic is relatively unimportant. An explanation of this situation naturally involves some speculation. Many of these seed stocks can be traced to a few growers who first undertook certification in this region. The original stock furnished them was probably of very high quality. This has been maintained by careful handling on the part of the growers who have had their problems simplified by the slow rate of spread of the virus diseases. This conclusion is supported in the first place by the isolation of many fields (one-half mile to several miles from other potato fields) and by the relative scarcity of known transmitting insects, particularly aphids. Regardless of the reasons for it, the situation is indeed encouraging for we thus have a large number of good foundation stocks available for home planting. All growers who give up their own seed are advised to replace it with seed from these sources.

A second feature of the program is the method for handling seed which carries a higher percentage of virus diseases than is desirable in foundation stock. Growers of such have been advised throughout the season to change seed. When the disease

summary was issued a group of the seed stocks representing 400 acres in the field (10% of the total acreage) was arbitrarily designated as ineligible for home planting in 1930. While it was inadvisable to follow a strict standard, in general, field readings of 1% or more spindle tuber or consistent mosaic readings of over 5% in the special tests were considered sufficient reasons for requiring that the seed be discarded. Recommendations were also made for the discarding of 150 more acres which were just within the standards noted above. Most growers have cooperated in this effort towards seed improvement and in many cases have volunteered to make the change even before the report was sent out. It is believed that a requirement of this kind, although a bit drastic, is particularly important at the present time in order to avoid introduction of virus diseases in certain sections and to prevent the further dissemination of the less desirable seed stock in other sections. The certification rules for 1930 will probably provide for a more definite recognition of the better seed as foundation stock. The general policy of those in charge of the certification work has been to cause as little individual hardship as possible while at the same time encouraging the grower to plant only the best seed. It is felt that the program as here outlined will decrease the cost of production and further improve the quality of the seed placed on the market.



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Acre Costs Versus Bushel Costs in Potato Production

C. M. McCRARY, Michigan State College, East Lansing, Mich.

Better quality potatoes at lower production costs has long been the object of potato extension effort. How best to accomplish this has also long been the purpose of a great deal of experimental work. The use of fertilizer, good seed, proper spray and cultural methods, have without a doubt, proven satisfactory in materially improving the quality of the crop produced. Many growers, while admitting that this is true, hesitate to follow recommendations on the use of these methods of improving quality because of the fact that all these practices increase the cost of producing an acre of potatoes.

This increased cost per acre is also no small item to be considered. Consider for instance, data which has been gathered in the past two years from 96 growers in the Michigan 300 Bushel Potato Club. These growers used on an average 22 bushels of seed per acre. Michigan's certified seed, over the past two years, has averaged 65c per bushel more than ordinary seed making it cost these growers on an average $14.30 per acre to use good seed. These same growers used on the average 530 pounds of a complete high grade fertilizer, the majority of which was 3-12-4 or 4-16-4. This amount is 250 pounds to the acre more than the amount used by the average Michigan grower or an added expense of about $5.50 per acre. Proper spraying costs add to this total. These men sprayed on an average of six sprays costing approximately $15.00 per acre for the material and applying same.

These three items, alone, namely fertilizer, seed and spray make a total increased cost per acre of $34.80. However, this increased cost of $34.80 per acre has enabled these 96 growers to obtain an average yield of 328 bushels per acre, a yield which is over 200 bushels per acre better than the average Michigan yield for those same years. These increases of 200 bushels per acre obtained at a cost of approximately $35.00 are the cheapest bushels of potatoes produced as well as the best.

However, acreage costs and bushel costs have an indirect ratio to each other. There may be exceptions to this as certain factors are found to enter that will alter conditions, but the data gathered on these 96 farms and divided into groups according to yield and costs would seem to bear out the above statement. This cost per acre on the high or low yields varies from year to year. This variation is due largely to cost of seed. Most other cost items are quite constant on fields that are in

about the same condition. Fertilizer, spray material, labor and other items may vary some, but as their total cost per acre is small it has little or no effect on change in acre costs. Seed, on the other hand, is a large factor. In almost all cases in data collected the seed cost, when using the best seed available, was higher than any other item, not excepting the man and horse labor item. Seed on the 1928 crop was worth, on the farm, an average of $1.85 per bushel, according to figures these growers gave. The 1929 crop prices obtained in the same way averaged 70c or a difference of $1.15 per bushel. This, on a 20 bushel planting, makes a difference of $23.00 per acre. Consequently, the acreage cost of 1928 was somewhat higher than 1929, but the relationship between cost and yield remains the same.

The table below compares these acre costs and bushel costs with the different yield groups for the 1928-29 crops.

	Average Yield	Average Cost Per Acre	Average Cost Per Bushel
Group I— (Over 400 bu. per acre)	435 bu.	*$117.25	$0.27
Group II— (350-400 bu. per acre)	372 bu.	113.94	.30
Group III— (300-350 bu. per acre)	314 bu.	106.00	.34
Group IV— (250-300 bu. per acre)	264 bu.	96.78	.36
Group V— (200-250 bu. per acre)	225 bu.	94.50	.42

While these figures are only the result of two years work, yet they were consistently uniform in the relationship between yield, acre costs, and bushel costs.

In checking back over the crop records on these fields we also find that the fields having the largest per cent of marketable tubers are those where acre costs were highest, indicating

*Included in these production costs are following items: land charge, man, horse and tractor labor charge, manure and fertilizer charges, seed, spray and treating material and a machinery charge. It does not include hauling to storage off the farm or storage or marketing.

that to improve quality it requires better care, better seed and those things which increase yields per acre. It is, therefore, necessary in discussing with the grower, the program of improvement of quality and more economical production, to discuss with him methods of increasing production per acre.

Potato Fertilizer Notes

ALBERT E. WILKINSON, Agricultural College, Storrs, Conn.

No one today disputes the fact that fertilizer is needed to grow potatoes profitably. You may have a number of questions on fertilizer that need proof. Do you know whether or not you are using the proper amount of fertilizer? Is it in the correct proportion? Does its availability meet the needs of your crop? Are you applying it advantageously and correctly? These are only a few of the practices on which you may want help.

What is a well balanced formula? A well balanced fertilizer is one that contains the principal plant food elements in a correct proportion. A formula in the ratio of 1-2-1 to 1-2-2 is well balanced and has been determined as meeting the needs of the potato crop.

1-2-1 to 1-2-2 explained means —

80 to 100 pounds of nitrogen.
160 to 200 pounds of phosphorus.
100 to 140 pounds of potassium.

A 5-8-7 or a 5-10-5 mixed fertilizer meets these requirements. Such formulas are in common use among our best growers.

The Storrs Experiment Station proved that—

100 pounds of nitrogen in a balanced fertilizer gave a better yield than 150 pounds. That—

160 pounds of phosphorus in a balanced fertilizer gave a better yield than any other amount. That—

120 pounds to 180 pounds of potassium in a balanced fertilizer gave the best returns.

Shall the early crop have quickly available plant food or not? Tests have been carried on in several states including Connecticut. The results have indicated that quickly available plant food for early potatoes is preferred. This quickly available plant food can be in the form of nitrate of soda, sulphate of ammonia, acid phosphate and muriate of potash.

What is best for late potatoes? Generally speaking late potatoes respond to less quickly available fertilizer. Therefore, fertilizers containing tankage either vegetable, fish or meat can be used in addition to the previously mentioned minerals.

How much fertilizer to use. Our recommendations are:

For Irish Cobblers—2000 pounds or slightly more per acre.

For Green Mountains—1200 pounds to 1600 pounds or slightly more per acre.

Do not be too liberal but do supply enough for the plant needs to produce a large crop. A small surplus of plant foods needed is a good practice.

There are growers who use too much fertilizer. This is wasteful extravagance.

Tests in Maine show that—

1000 pounds fertilizer increased yield over no fertilizer 44.3 bushels per acre.

1500 pounds fertilizer increased yield over no fertilizer 55.4 bushels per acre.

2000 pounds fertilizer increased yield over no fertilizer 61.4 bushels per acre.

The last 500 pounds of fertilizer costing $11 to $12 returned only six bushels increase. This increased value (average) in dollars may not pay its cost.

A survey on Long Island, New York on several hundred farms showed that approximately $35 to $40 per acre was enough to invest in fertilizer for the largest profitable yield.

How to apply fertilizer. The common practice with Irish Cobblers in Connecticut is to apply all the fertilizers in the furrow

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or drill. All good planters are equipped to sow the fertilizer in the furrow. With Green Mountains it is applied similarly, though at present many of our better growers find it less expensive or quicker to apply all fertilizer broadcast and harrow it in without decrease in yields.

Tests in Connecticut, Maine and other states show little difference in method of application. A late test, 1929, in Connecticut illustrates this point in part:

All fertilizer in drill vs.	half in drill, half broadcast.
1500 lbs., 319 bu. per acre No. 1;	342 bu. per acre No. 1.
1750 lbs., 339 bu. per acre No. 1;	333 bu. per acre No. 1
2000 lbs., 315 bu. per acre No. 1;	331 bu. per acre No. 1

Whether to broadcast all fertilizer, or to place part in the drill and part broadcast; or all in the drill can be determined by each grower. The practical method is that which costs less or can be done quicker.

Knobby Seed May Be Good Seed

C. L. FITCH, Ames, Iowa.

The purpose of this paper is to give a little evidence from comparative trials and one large piece of field evidence, that knobby seed potatoes may be good seed, and yield well.

The varieties which are of commercial importance in Iowa are the Early Ohio, the Irish Cobbler, and the Rural New Yorker. Of these, only the Early Ohio, has any serious tendency to form knobs or second growth. This tendency with the Early Ohio is so serious on light peat soil as to render its commercial production on these lands impracticable. The common assumption has been that alternating drouth and rain are the causes of second growth, but observations suggest that on peat beds, at least, rhizoctonia lesions are the more important and more frequent cause of knobby potatoes.

In the years 1907 and 1908, I made comparative trials in rows each year on a farm in the Greeley district of Colorado of Early Ohio seed potatoes: (1) which were pointed; (2) which were knobby and (3) which were of good shape—all samples being from the same bin and the same crop. We secured decidedly less crop from the tubers which had pointed ends and undue length, but apparently the knobby seed was just as good in yielding power, as the better shaped tubers of the same lot.

The Extension Service of Iowa State College, and the Iowa State Vegetable Growers' Association long have conducted yield tests of seed potatoes, and now are undertaking similar tests of other seeds. The best Early Ohio stock we ever have found,

as tested for a long term of years for yielding power and quality of product, comes from Mr. Albert Peterson of Rhinelander, Wisconsin. Other lots from other places have been good, but none of them has with us quite so good a record.

In 1927, Mr. Sam Kennedy, Jr., of Clear Lake, Iowa, planted twenty bushels of Albert Peterson Ohios on a piece of peat south of the town of Clear Lake. A part of this piece proved to be not well drained and all of the Ohios suffered considerably from rhizoctonia lesions. A large part of the crop, in fact practically all of it, showed second growth and the bright red color which so often accompanies rhizoctonia infection. The crop would grade as peddler stock, and would have had to sell at a serious discount. I told Mr. Kennedy that in my judgment, it would be good seed. He had had a little experience in the same direction, and he stored the crop and used it for seed purposes.

In relating orally the results secured from this seed, I have found potato specialists often so pathologically minded that they could not separate readily their ideas of physiological qualities, from the effects of the disease itself on the crop finally secured from such seed.

I wish to make it clear that this seed was well treated by the hot formaldehyde method and that therefore any sclerotia of rhizoctonia had very little to do one way or the other with the result I now report. The purpose of this paper is to give some evidence which indicates that rhizoctonia, speaking physiologically or in terms of the yielding power of seed produced by plants affected by this disease, is not a degenerative disease.

Mr. Kennedy planted this seed in 1928 on a piece of very rich sandy loam upland soil which had been manured a number of times in the last ten years. He used more than twenty bushels of the seed per acre. He harvested and sold from the ten-acre patch, 4000 bushels of smooth, beautiful Early Ohio potatoes—a record yield.

Evidently this knobby seed was good seed.

Crop and Market News

MARKETS RATHER DRAGGY

(Contribution from the Bureau of Agricultural Economics)

Condition of the potato market in mid-February was not so encouraging as it had been, and some growers who intended to increase their plantings this year may change their ideas. Preliminary reports an acreage which growers intend to plant in 1930 indicate a total potato area of 3,570,000 acres. This is nearly 6% larger than the area harvested in 1929. If the intended acreage for 1930 is planted and a yield in line with the

trend in recent years is secured, the total production in the United States would be around 421,000,000 bushels, which would be about the quantity produced in 1924 when the December 1 farm price was 62.5c per bushel compared with 131.4c per bushel on December 1, 1929.

Although holdings of old stock are relatively light, prices recently have been declining. However, wholesale prices in city markets are fully twice those of a year ago, and the general f. o. b. level is nearly three times that of February, 1929.

Available stocks of potatoes on hand January 1, in 35 late-producing States were estimated at 84,000,000 bushels or about the same as in 1927 but 47,000, 000 less than a year ago. In the 19 surplus-producing States, which furnish most of the carlot shipments, the January holdings were about 74,000,000 bushels, compared with 110,000,000 last season. Maine and Washington were about the only States having heavier supplies than a year ago. In the 16 deficient late-potato States, the January stocks were 10,000,000 bushels, or only about half the holdings of last winter. Because of the relatively high market prices, smaller quantities of potatoes than usual are being kept on farms for food. About 67% of the 1929 crop in the late States met requirements of U. S. Grade No. 1, or 3% more than the year before.

Shipments averaged about 4,500 cars each week since the middle of January, or slightly less than movement for the same period last season. The weekly output for early February has increased to 5,000 cars.

Declines averaging 10c or 15c per 100 pounds were quite general during the month. Northern Round Whites were bringing $2.35-$2.55 in the Chicago carlot market, but Idaho Russet Burbanks held rather firmly at $3.10-$3.25. The jobbing range for eastern potatoes in large consuming centers was $2.65-$3.50 per 100 pounds. The f. o. b. price of Round Whites in western New York has declined to a $2.40 level, and shippers of Maine Green Mountains received only $2.10-$2.20. The North Central price was $2.20-$2.40, while most of the western potatoes returned $2-$2.45 at shipping points. Considerable shrinkage and loss is reported in holdings of Yakima Valley potatoes, so that available supplies there will be reduced. The price of loaded cars of Russets advanced to a range of $42-$44 per ton.

In spite of the dullness of the market in United States, imports have been arriving rather actively in New York from Cuba, Bermuda and Esthonia. Several markets were getting sizeable quantities from Canada. New potatoes were jobbing somewhat lower at $10-$13.50 per barrel, or $3.25-$4 per bushel. Movement from Florida was gradually increasing. The January freeze did some damage to plantings in southern Texas.

Notes

PENNSYLVANIA

The annual meeting of the Pennsylvania Potato Growers' association, held during the regular Farm Products Show week at Harrisburg, Jan. 22 and 23, had an average attendance at all of its sessions of about 700. It held a banquet Wednesday evening with an attendance of about 400.

The Pennsylvania Potato Growers' association being chiefly an educational organization, naturally would have a program of discussions on production problems largely centering around the methods followed by our 400 bushel growers of which there were 81 in the state this year as compared to 377 last year. Another half day session was given over to marketing. Here discussions centered around such questions as standardization, advertising Pennsylvania potatoes, and marketing under a brand name. A committee was appointed by the association to work out a scheme of standardization fitted to the conditions of the Keystone State, the state in which most of the marketing is done direct between the producer and the consumer or between the producer and the retailer.

There was no indication from the general sentiment and spirit of the meeting that the potato acreage in this state would be increased in 1930. —MILES HORST.

FLORIDA

I have found local fields of Bliss Triumphs planted with northern uncertified seed showing as high as fifty per cent of mosaic and a small percentage of leafroll. On the other hand I visited last week large fields of certified Bliss Triumph and Spaulding Rose, being grown by parties of Virginia and Long Island, in which practically no disease was seen. The tubers are about half grown in these fields, although locally grown Triumph potatoes are now on the market in Miami, retailing at three pounds for a quarter or $3.75 per bushel. Attractive profits will be realized on the potatoes that are being marketed now. One of the remarkable features of this climate is that two or even three crops may be grown in a season on the same land.

There is a marked increase of interest in potato growing in this section due to the recent discovery that a previous serious lack in soil fertility—for potatoes and other vegetables—may be corrected by the addition of manganese to the usual complete potato fertilizer. It is not yet entirely clear how the manganese functions in this connection, but satisfactory growth can be secured with its use. To a ton of complete fertilizer about 300 pounds of manganese is added. About 1000 acres of potatoes are

being grown in the immediate vicinity of Miami where the acreage was only 300 last year. Much larger acreages are being developed in the Lake Okeechobee region, northwest of Miami. No late blight has been observed here up to this time (January 30th), although conditions of temperature and moisture would seem to have been favorable. —ALBERT H. GILBERT.

Review of Recent Literature

"Field Plot Technique with Potatoes with Special Reference to the Latin Square."—Kirk, L. E., Scientific Agriculture 9 (11); 719-729, 1929.

The importance of taking into account the factor of soil variability is now widely recognized by those who conduct field plot tests with crop plants. It is not generally appreciated how an estimate of the error due to this cause may be improved by a favorable arrangement of plots. If the standard error can be reduced thus to one-half, the value of the experiment is increased at least four-fold.

A special arrangement of plots known as the Latin Square deserves and is receiving careful consideration (1) because it serves to illustrate certain fundamental principles in field plot testing, and (2) because it provides one of the best control methods for making an accurate comparison of a few varieties or treatments. The favorable result obtained by arranging plots in a Latin Square is due to the fact that this method lends itself to the Variance method of analysis. The variance due to rows, columns, and varieties is subtracted from the total variance leaving only that due to random sampling. In this way the effect of correlation between plots is eliminated and the probable error is reduced accordingly.

In potato testing it is especially desirable to secure the greatest possible accuracy on the smallest possible area of land both because potatoes appear to be especially sensitive to soil differences and because so much hand labor is required in potato testing work. The results reported by the writer provides a direct comparison between the Latin Square arrangement of plots and the usual systematic distribution. Comparing the two methods where the area occupied was the same, the reduction in variability of the former over the latter amounted to 27 per cent. Under the conditions of the experiment and with a 200 bushel per acre crop, the Latin Square would require a difference between varieties of 12.4 bushels per acre to make

reasonably sure that a difference in yielding capacity was observed whereas a difference of 34.5 bushels would be required when the plots in each replication series followed the usual systematic distribution.

An illustration also is given of the Variance method of yield analysis and formulae adapted to machine calculation suggested which are designed to facilitate the work of making the necessary mathematical determinations from Latin Square data.

AUTHOR.

Potato Investigations in Germany, 1923-26. G. Schneider, O. Schlumberger, K. Snell, Mitt. Biol. Reichsanst, Landw. u. Forstew, No. 36, Jan. 1928. 125 pp.

This publication is a report of a large number of experiments conducted in various parts of Germany over a period of four years. These deal with tillage, crop sequence, fertilizer, seed, planting, varieties, origin and effect of growth conditions on seed stock, breeding work, diseases and their control, harvesting, storage, etc. The lines of work reported that appear to be of the most interest to American potato students will be reviewed briefly.

Seed potatoes of four varieties were sent out to thirteen stations and at the end of the first year were returned for trial both at Dresden and at Leipzig. Results at both trial stations were very similar. Potatoes grown at five of the thirteen places always declined in productivity whereas at the other eight places original vigor and productivity was maintained. The varieties Heimat and Centifolia suffered less than the varieties Pepo and Pirola.

When potatoes were grown continuously at Pommritz and Probstheida there was a slight but steady decline in yield with each succeeding year. In such localities the recommended procedure is the procuring of small amounts of seed every one or two years and increasing this for large commercial plantings. However, when grown at Leipzig the degeneration was very rapid, necessitating the use of new seed stock each year.

Reviewing the work at Dresden for 1922-1924 the statement is made that the yield decline of a lot of good seed is comparatively very small on mountain land after one or two years. The yields from seed grown on sandy or loamy soils are generally below those from the original source. On the weathered soils the productivity of the progeny frequently exceeded the original source, especially when produced at altitude 400 meters, with further improvement when produced at 750 meters. Some varieties as Richter's White Ripe are considered good under all condi-

tions, others are considered as having special adaptions and some degenerate under all conditions.

Degeneracy was reported as being much more rapid than usual in 1923 and less so in 1924. On poorly drained soils degeneracy was not as rapid in the dry summer of 1925 as in previous years.

Potatoes of two varieties (Industry Pearl and Heide Pearl) were planted on six different soil types in the experimental garden at Dresden in 1925. In the potatoes from all soil types degeneracy was found to have proceeded about equally in 1926.

The question of the effect of the amount of soil moisture used in producing a crop of seed potatoes was studied from 1922 to 1926, at Bernburg with the variety Rhineland. The low soil moisture seed was the least productive.

Roguing diseased plants for four to six years at Hirschfield (loam soil) slowed up degeneracy somewhat in two varieties, but at Kreinitz (sand soil) no appreciable effect was observed. The statement is made that "in degenerating soils and with degenerating varieties roguing is worthless." It is considered more valuable with the more favorable soils and resistant varieties.

Seed potatoes of the variety Bernburg from plats planted May 2 and harvested Oct. 15 were more productive the following years that those harvested immature on Sept. 15 or about equally immature stock from June 15 plantings harvested on October 15.

When potatoes were harvested at Hanover at different intervals, beginning on Aug. 5, (when in full bloom), with the second digging on Sept. 7 (end of blooming), and the last one late September or early October (when vines were mature), the seed value of the two early and middle early varieties was not affected but with the mid-late varieties the midseason harvested seed tubers were the most productive.

The tests at Berlin, to determine the effect of nitrogen manuring upon seed value of tubers produced, could not be considered very conclusive. Tests along this line conducted at three places in Saxony indicated that one sided fertilizers were injurious to seed. However, heavy applications of reasonably balanced fertilizers did not prove injurious to the seed potatoes.

The length and weight of sprouts produced in the greenhouse by seed potatoes, while not always dependable, gave worth while evidence concerning the seed quality of the potatoes, according to tests conducted at Dresden in 1924-25.

Storage as a factor affecting seed potato quality was studied at Wurtemberg from 1920 to 1925. The most satisfactory cellars were those in which the temperature averaged 2° C, the poorest had a temperature of 8° C. and those with over 6° C. average were unsatisfactory. Damp cellar floors and piles not over 6½ feet deep were found to be very desirable.

Early uncovering of pits was found desirable in order to avoid the loss resulting from respiration, rotting and sprouting in the spring. With potatoes stored from October, 1925, to May 8,

1926, there was a shrinkage of 15% in weight when the straw cover was removed on March 15, compared with a loss of 18% when only the ridge was uncovered on that date and 25% when the potatoes were kept under winter cover till May 8.

(Throughout the various reports herein reviewed the possible relation of diseases, especially virus diseases, was practically never mentioned. The question therefore, arises as to whether the differences reported from Germany were due to the direct effect of the environmental conditions or whether these conditions differentially influenced the spread of diseases.)

—H. O. WERNER.

Influence of Fertilization on the Health of the Potato

(Title Translated.)

Die Ernahrung der Pflanze, Vol. 25, No. 9, p. 194-198, May 1, 1929.

I. Comparison between German and Hollandish opinion concerning degeneration and the possibility of a solution.

Dr. H. M. Quanjer (Wageningen, Holland).

Reviewing the newer German investigations concerning degeneracy Quanjer points out that Lindner in 1926 was the first to conclude that the favorable effect of moor land (in north Hannover) upon seed potatoes depended upon the abundance of amid nitrogen. Referring to the work of Koltmeier, Quanjer states,—

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"He compared potatoes from moor and sand land in North Hannover where no degeneracy occurs with potatoes from humus sand land in the Province of Saxony, where degeneracy occurs." Koltmeier concluded that the amid content could be used as a basis for judging the value of seed potatoes but Quanjer considers both his data and that of Kruger as unconvincing.

In referring to his personal observations in the countries of west and north Europe and in the countries of North America the author states that he has never observed degeneracy that was not identified as caused by a virus disease. He makes the following enlightening statement: "In Germany people think that degeneration exists as a direct result of the influence of the ground. The author found further, that the climate is of greater significance in the beginning of the disease than the ground. In Great Britain, which extends between the 59 and 50 degrees of latitude, we know that from time immemorial, in the north the potatoes remain healthy, in the south they become sick. In Holland and Denmark those produced by the seaside, those in Holland out of loamy soil and in Denmark out of sandy soil remain healthy; in the east, those produced in Holland out of sand and moor soil and in Denmark out of loamy soil, become sick (Gram). That potatoes in the Danube Valley remain healthy is to be attributed to the later spring frosts; briefly stated the climate resembles more the Scottish climate than the southern. In the mountains also the potatoes remain healthy. The Magnum Bonum variety which in Germany has "run out" is still healthy in Scandanavia. The Champion, which in Ireland was "run out" was further improved out of Scottish material (Davidson).

"When one conducts investigations upon an influence of climate or soil with absolutely healthy potatoes in an environment where no infection occurs, then it is impossible to establish degeneracy. When one plants among the healthy potatoes only one diseased one, then this becomes the source of infection. This spreads from the plant, much in a mild climate, a small amount in a severe climate. This is because the plant lice which carry the virus diseases (Schultz, Folsom, Oortwijn Bootjes, Elze) have little resistance against a severe climate. They (virus diseases) make their appearance first the following season when the tubers of each plant are separately planted."

Experiments conducted in Holland showed that plants heavily fertilized with nitrogen bloom later than the other and still have young sprouts when others are approaching maturity. These young sprouts are fed upon late in the season by disease carrying aphids. With consequent later harvesting or heavy nitrogen fertilized plats the virus has more time to work down into the tubers. Doolittle (with cucumbers) and Bonig (with tobacco) are reported as showing that mosaic advances most rapidly in vigorously growing plants. Loew and the author both found that potassium poverty was conducive to the development of plant lice.

—H. O. WERNER.